Simulation of Edge-Plasma Modification from Large Lithium Influx at the DiMES Location*

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Goal, Method, and Summary

Goal: Simulate collapse of edge plasma in DIII-D shot 105511 from large lithium influx to benchmark full SOL impurity transport models

Method: Time-dependent UEDGE transport code with toroidally symmetric lithium gas injection

Justification: Although DiMES is localized toroidally, parallel flow will help establish toroidal symmetry in a time $2\pi R / Cs \sim 10^{-4}$ sec; various uncertainties, but plasma detached state can help

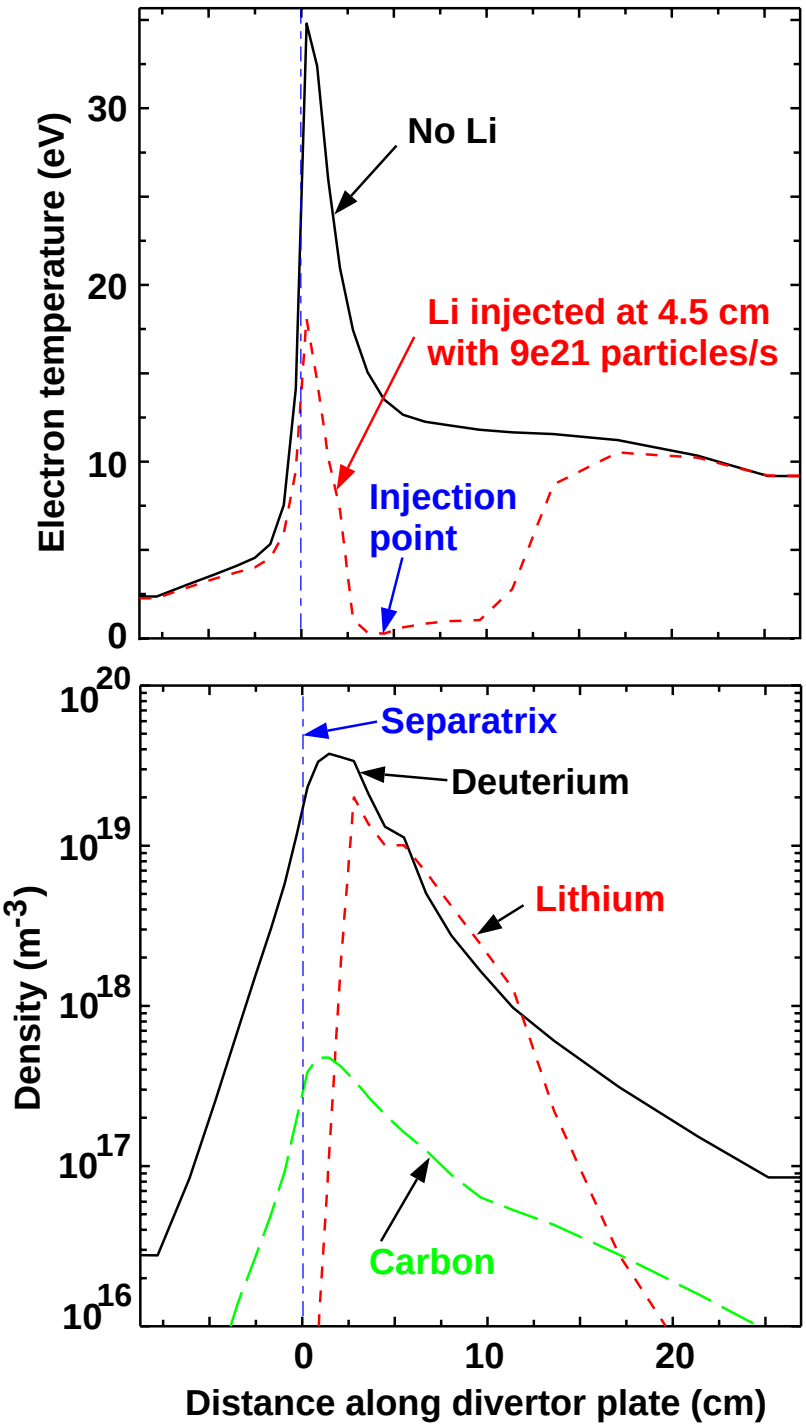
Main results:

1) **Large lithium evaporative flux from the divertor can lead to divertor and core thermal collapse**
2) **Lithium enters the core through the X-point**
3) **Very high DiMES temperatures (~1100 K) are required to give needed Li flux (see Whyte)**

Lithium point-injection on outer plate depresses T_e locally

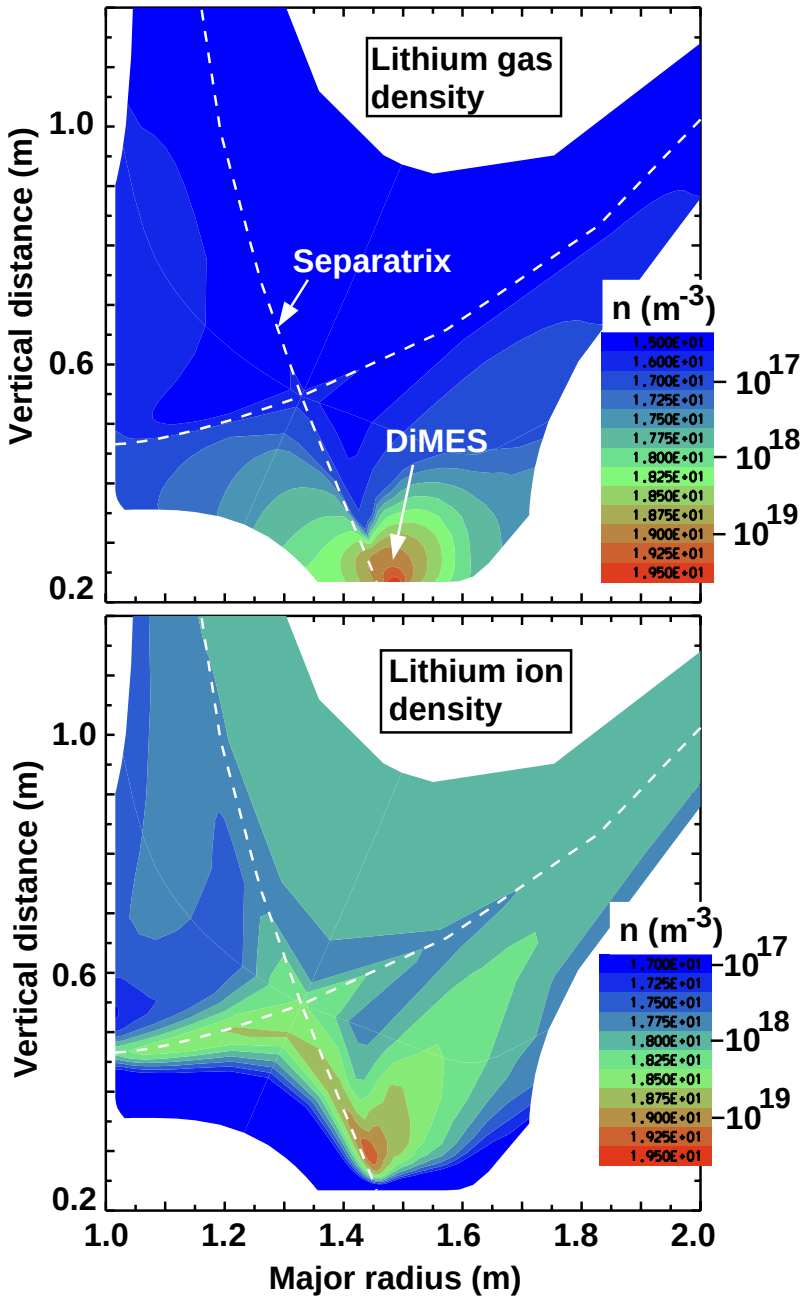
Li injected at one mesh point to model DiMES probe

Core power is 0.8 MW, C rad. = 0.19 MW, Li rad. = 0.14 MW



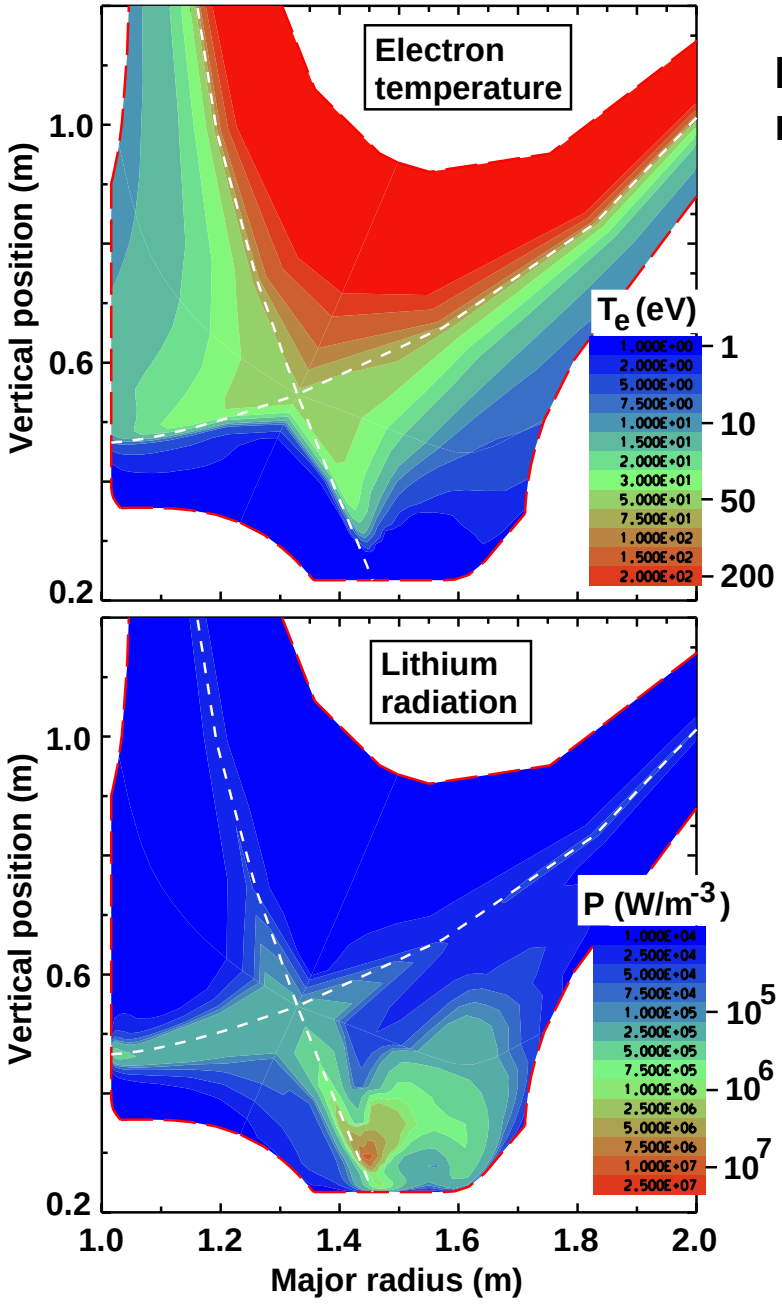
Assumed Li source of 5×10^{21}/s from DiMES probe location yields a steady-state plasma

- Calculation uses toroidal symmetry
- If localized to actual DiMES area, flux of $10^{25}/m^2s$ implies a surface temperature of 1050 K
- Hydrogen sputtering coeff. of Li would need to be ~10^3



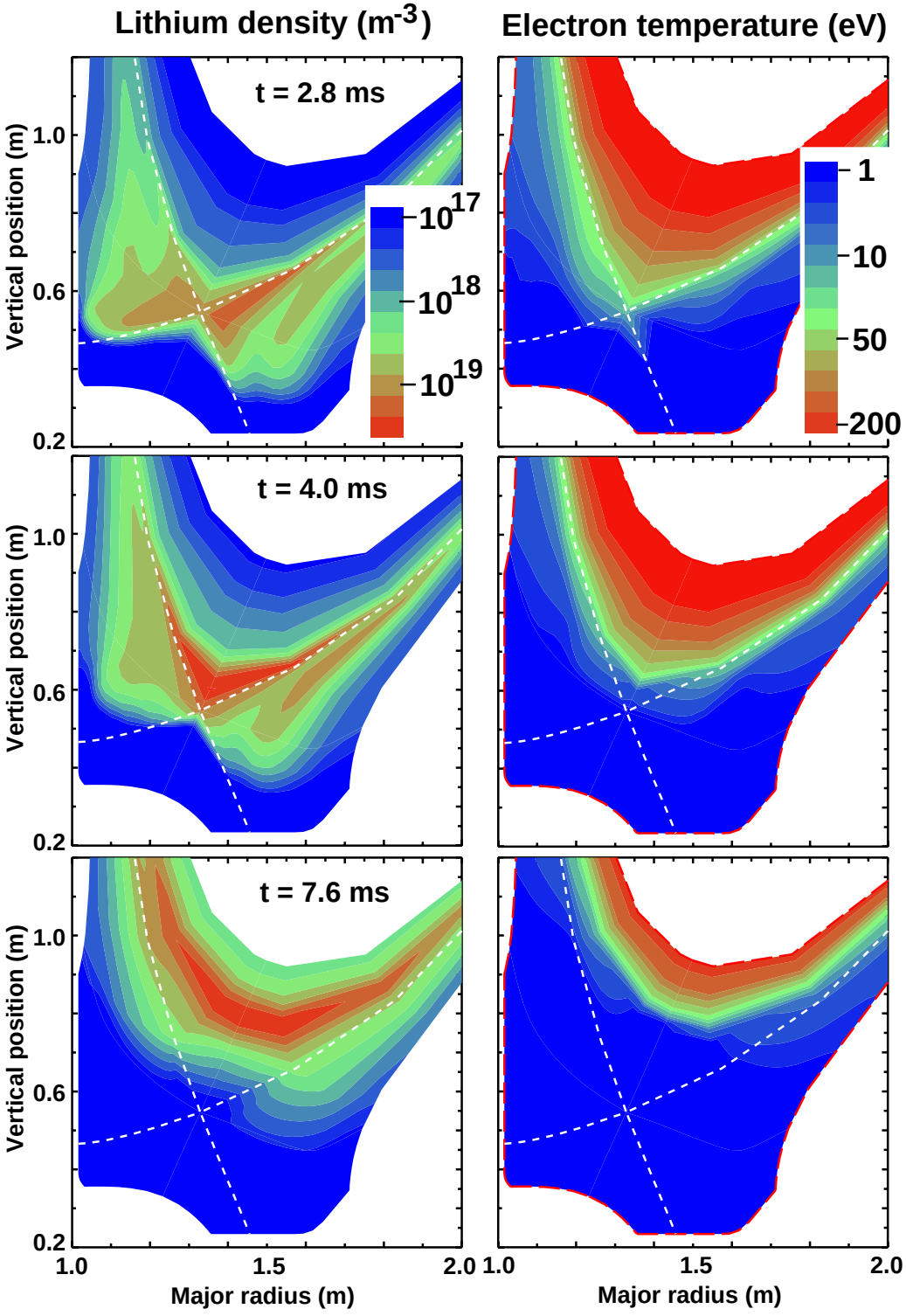
Lithium radiation loss near DiMES location causes T_e collapse at the outer plate

- Heat flux to the outer plate substantially reduced
- Lower heat flux should reduce DiMES heating, but time-history can be important
- Neutral lithium can escape from the near-plate region



Lithium source rate 5×10^{21} /s

Temporal evolution shows lithium influx through x-point for source of 2.5×10^{22}/s



Plans & questions for DiMES modeling

- Closer comparison with data (Te, radiation)

- Understand difference with CDX-U drops - core ablation versus periphery gas influx?

- Influence of ExB drifts

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- Cause of overheating or ablation of injected blob